



***Hydrodynamic and Hydrologic  
Feasibility Assessment  
Chinook River Restoration Project***  
**The 2003 Lower Columbia River and  
Estuary**

**Research Needs Identification  
Workshop**

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March 24, 2003

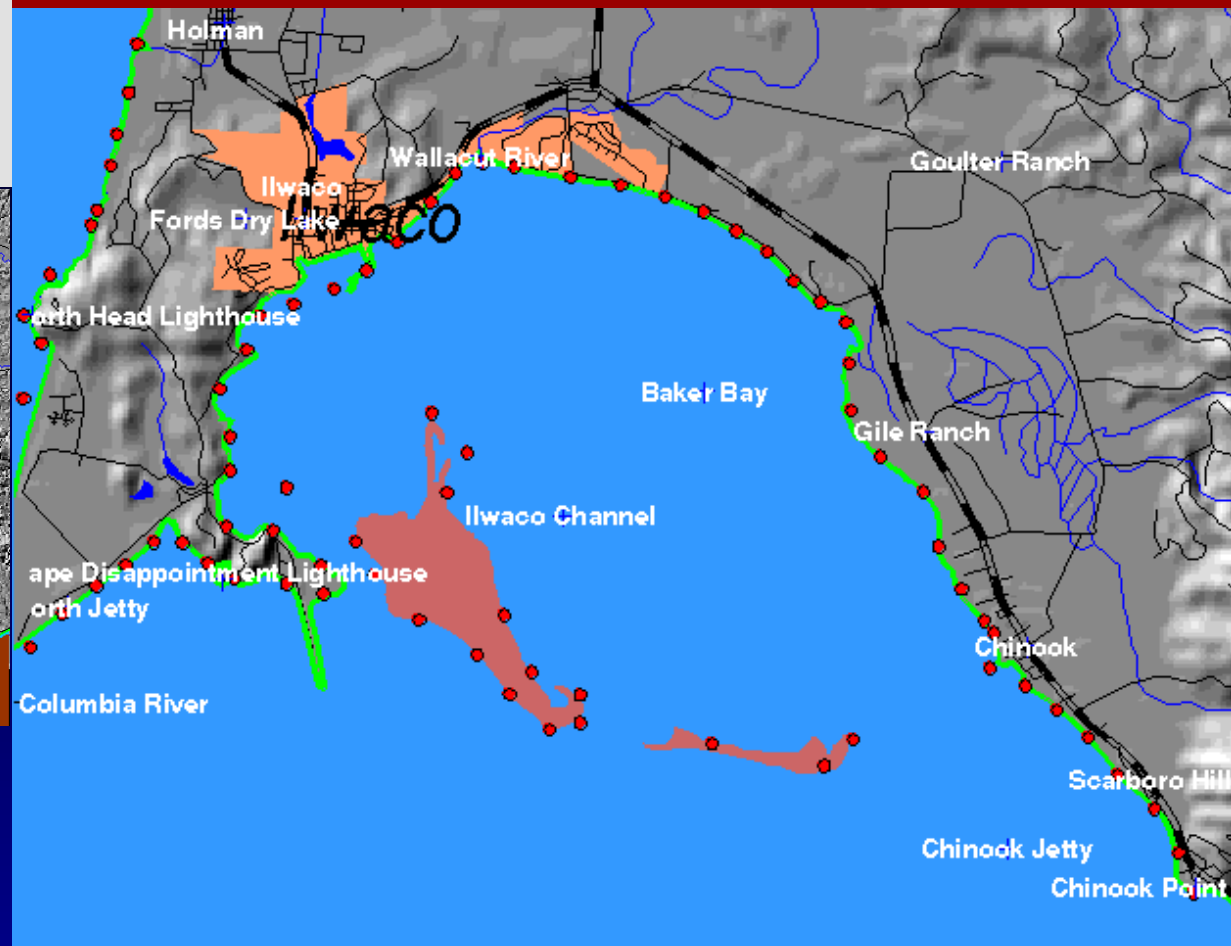
## Vicinity Map

Project  
Area

Washington

Oregon

# Chinook River Restoration



# Existing Conditions





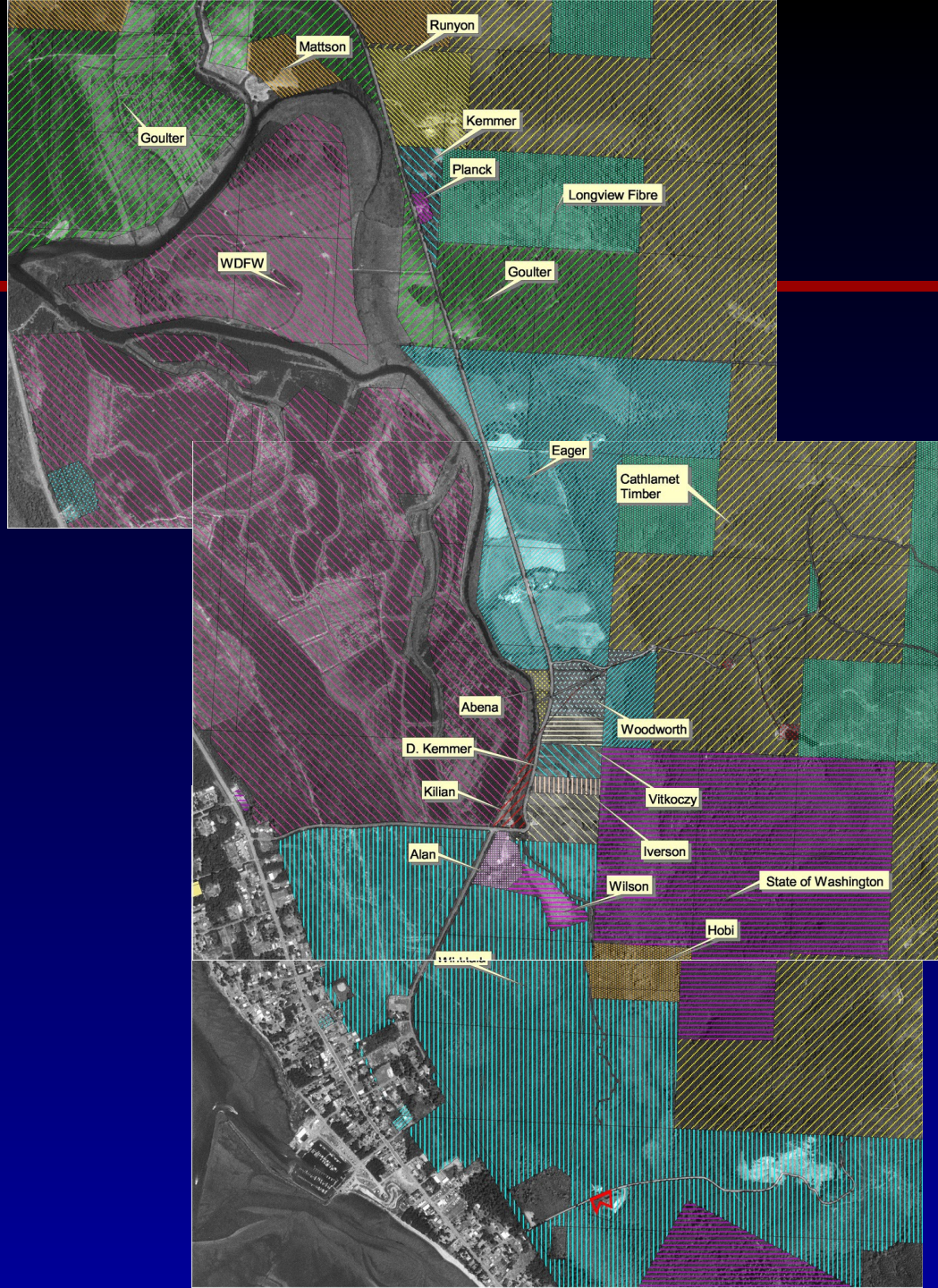
# Tide Gate at Causeway





# Estuary Restoration Study Objectives

- Recovery of Natural Estuarine Habitat through Restoration of Natural Tidal Flows
  - Modifications to tide gate
  - Modifications to internal channels
  - Construction of internal dikes





# Approach

- Data review and identification of gaps
- Conduct field data collection
- Setup/calibrate hydrologic model
- Setup/calibrate hydrodynamic model
- Evaluate Proposed Restoration Alternatives



# Hydrologic Modeling Basins



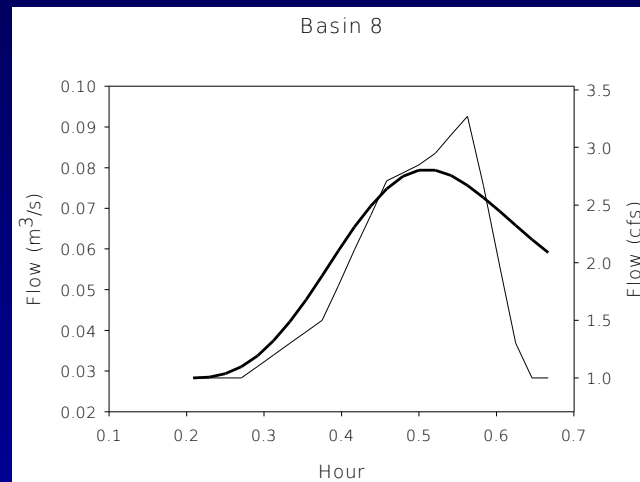
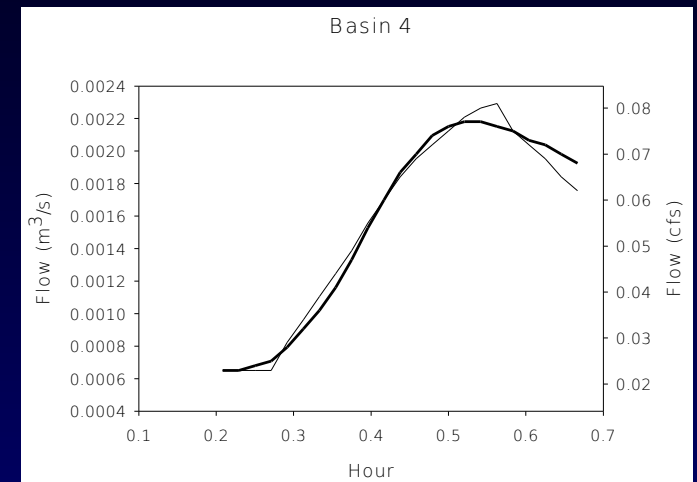
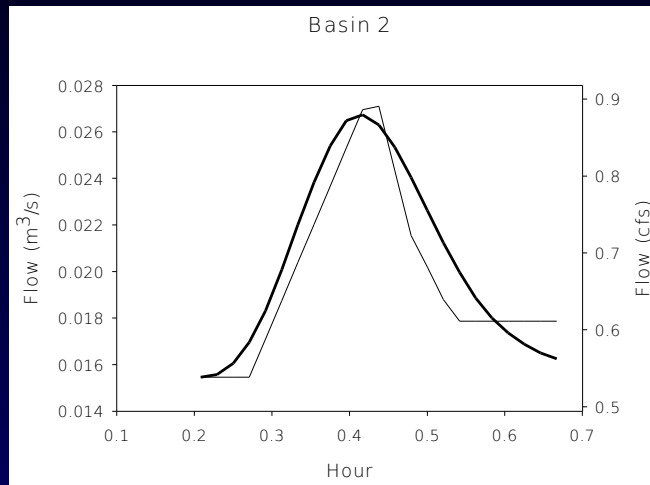
P:\projects\_2001\ducks\_unlimited\basin\_analysis.mxd January 13, 2001

# Field Data Summary

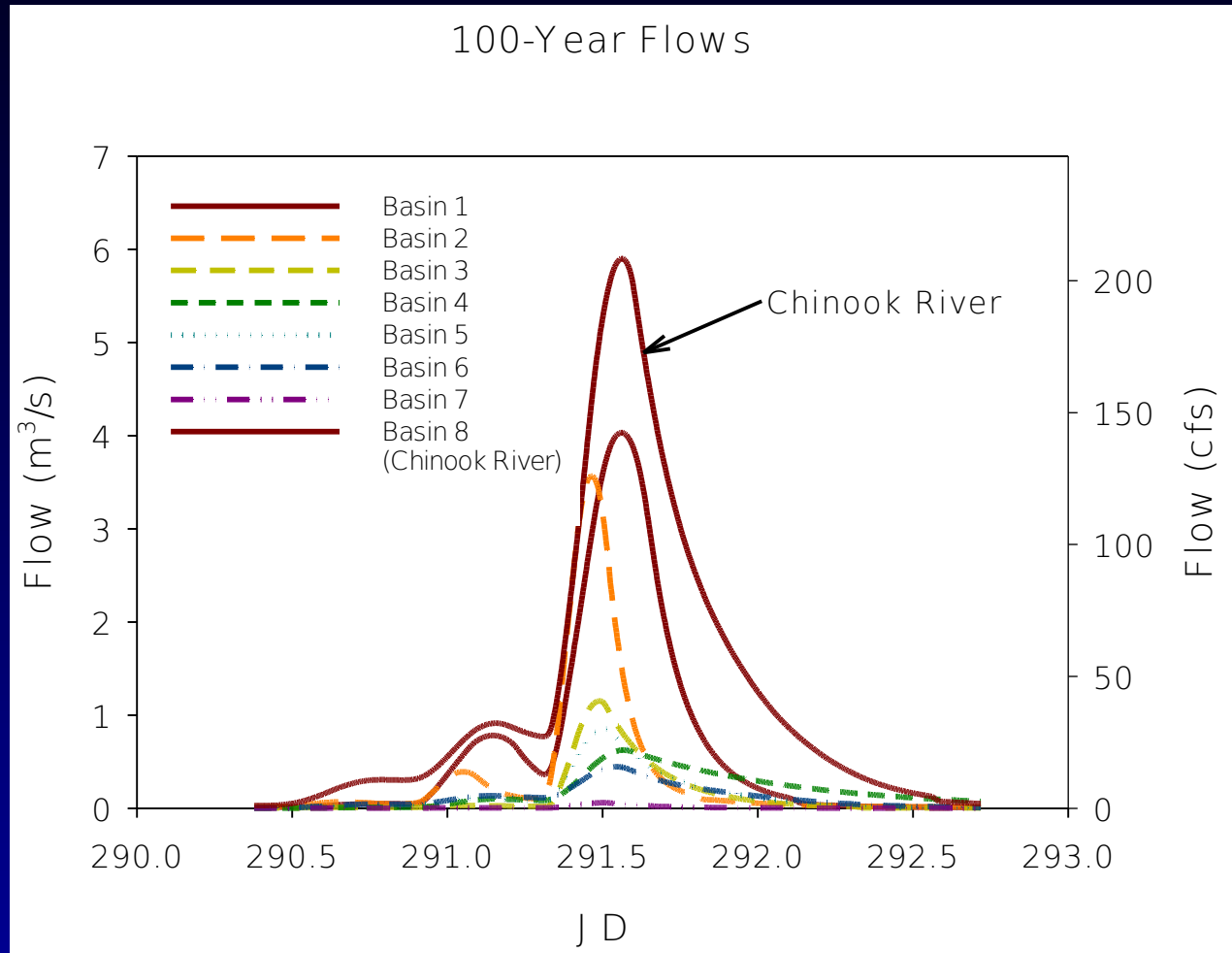
| Data Collected                            | Instrument/Method                                                          | Measurement Period                                                         |
|-------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|
| <b>Hydrodynamic Model Data Collection</b> |                                                                            |                                                                            |
| Channel Thalweg                           | Fathometer, GPS by boat                                                    | During 1st sampling period                                                 |
| River Cross-sections                      | Collected by DU                                                            | Prior to field program                                                     |
| Bathymetry Downstream of Tide Gate        | Fathometer, GPS by boat                                                    | During 2nd sampling period                                                 |
| Velocity Time Series                      | S4 current meter, 3 Aquadopp current meters                                | 2 two-week sampling periods during field program                           |
| Salinity and Temperature Time Series      | S4 current meter                                                           | 2 two-week sampling periods during field program                           |
| Stage Time Series                         | Seabird SBE 26                                                             | 2 two-week sampling periods during field program                           |
| Salinity and Temperature Profiles         | Hydrolab                                                                   | Profiles measured at 4 locations before and after each sampling period     |
| <b>Hydrologic Model Data Collection</b>   |                                                                            |                                                                            |
| Spot Velocity                             | Marsh McBimey current meter                                                | Measured velocities at road crossings during storm event                   |
| Infiltration Tests                        | Measured time to infiltrate known volume of water through a contained area | Conducted infiltration tests at three locations during 1st sampling period |



# Hydrologic Model Calibration Results



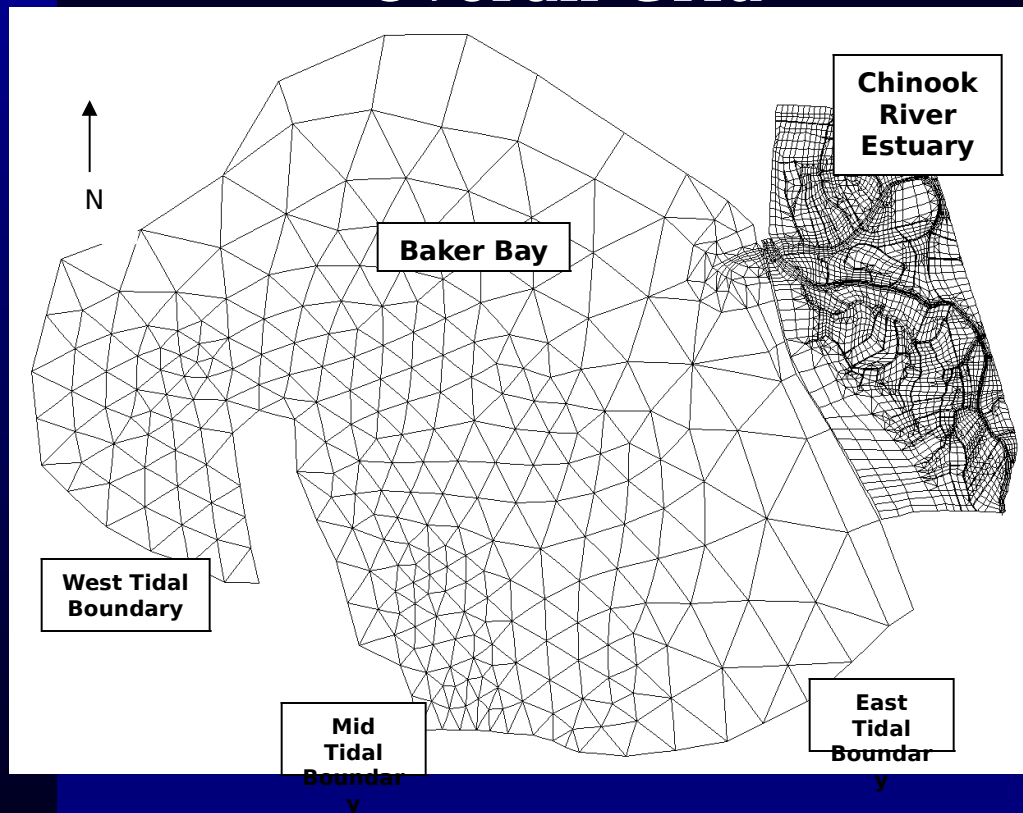
# Hydrologic Model 100-Year Simulation



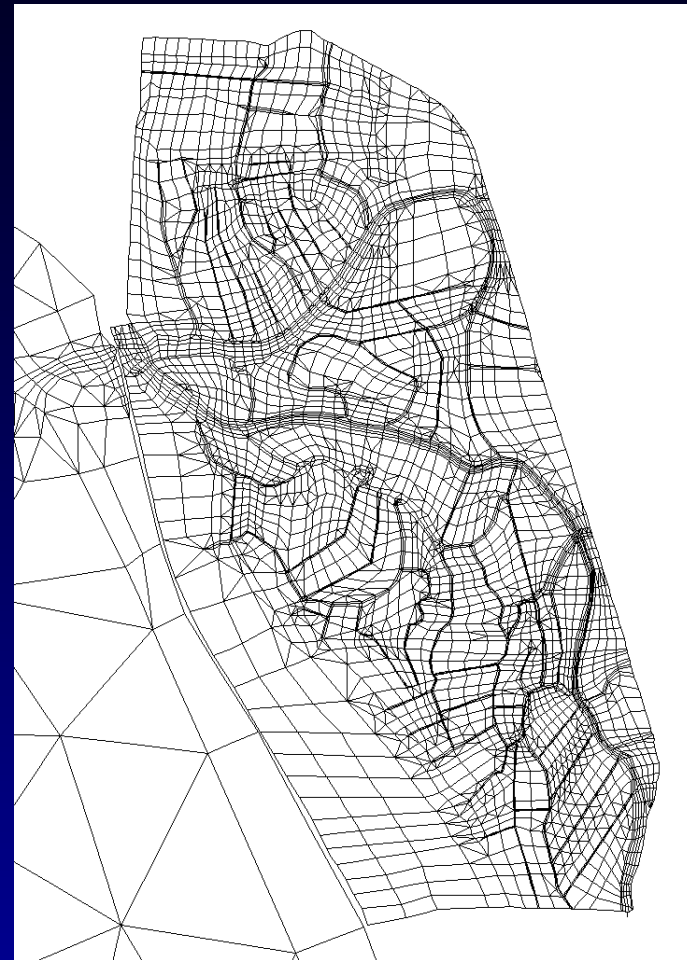


# Hydrodynamic Model Setup

## Overall Grid

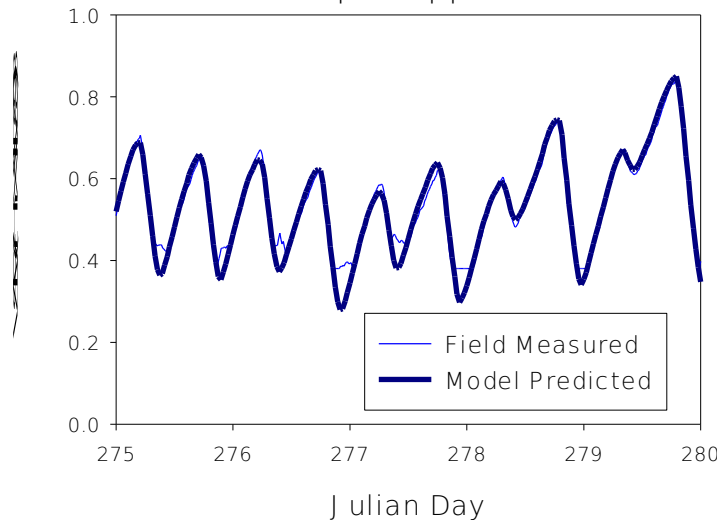


## Grid Detail

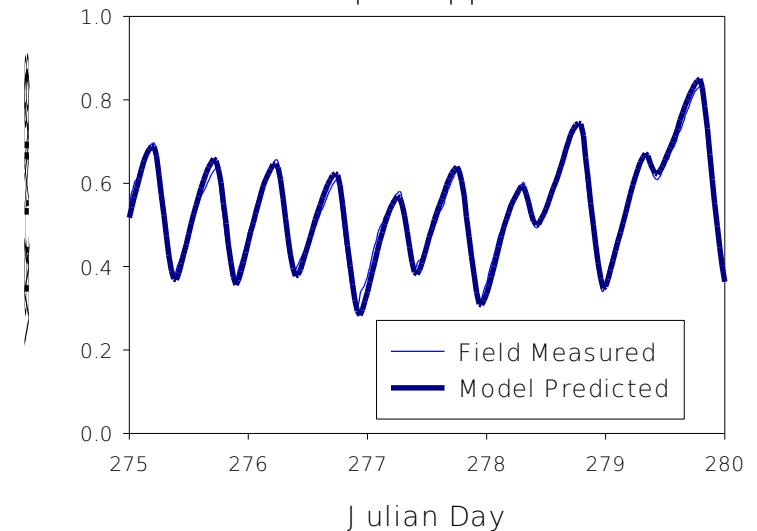


# Hydrodynamic Model Calibration Water Surface Elevation

Compare Measured and Modeled  
Water Surface Elevations  
at Aquadopp #344

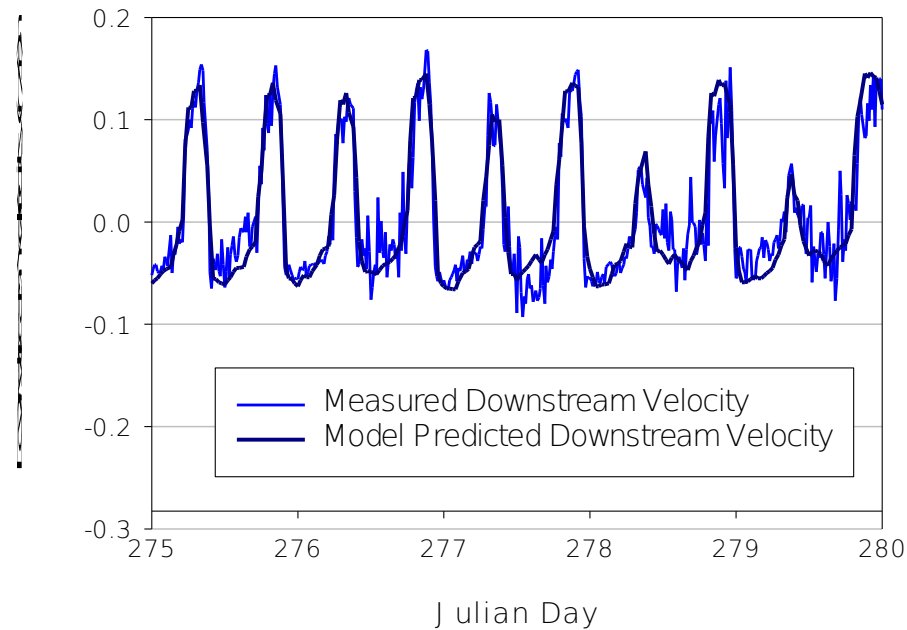


Compare Measured and Modeled  
Water Surface Elevations  
at Aquadopp #418



# Hydrodynamic Model Calibration Velocity Results

Compare Model Velocities to Measured Velocities  
at Aquadopp #415





# Model Application

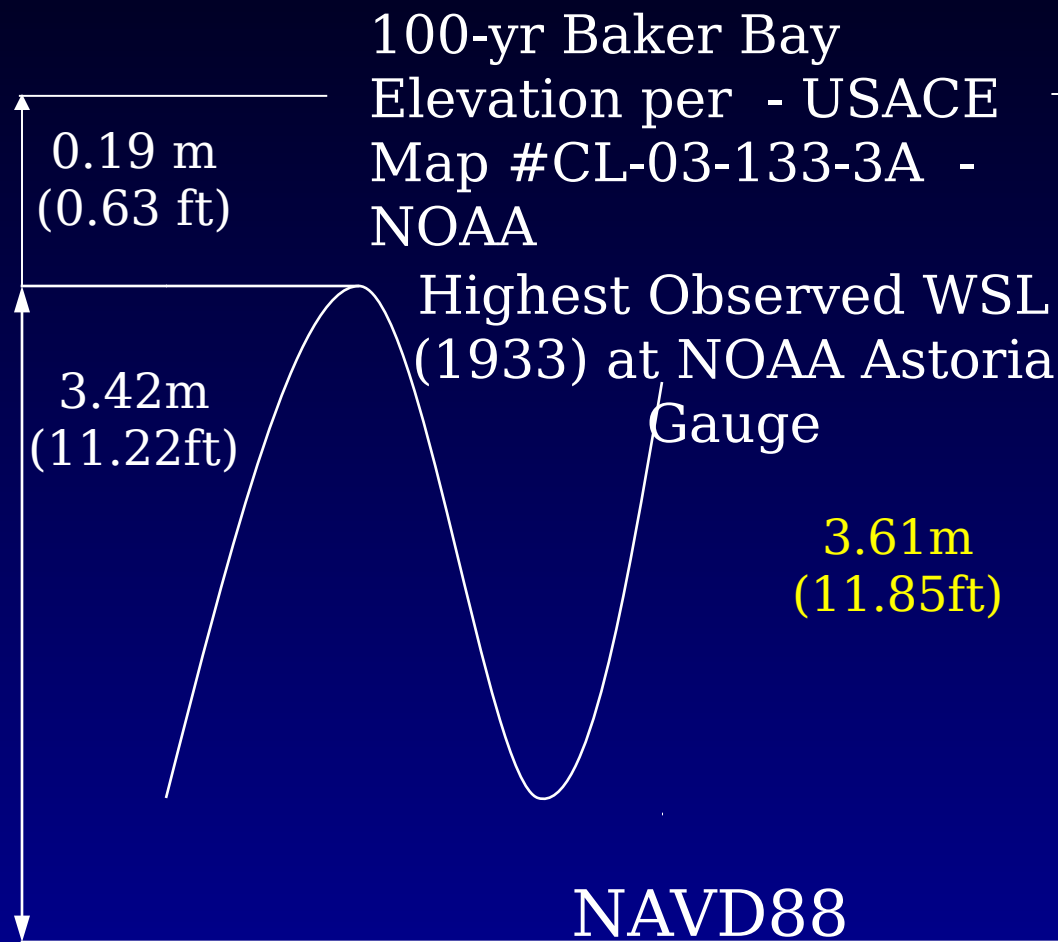
*Using observed tide and synthesized 100-year surge and upland inflows*

*for each of the following scenarios:*

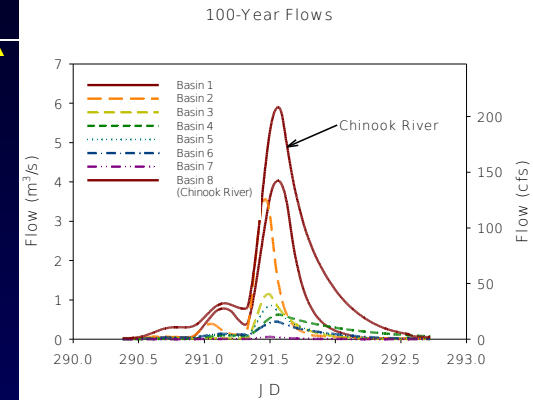
- 1. Existing conditions with leaky tide gate
- 2. No tide gate, keep existing 28' opening
- 3. No tide gate, opening at 56'
- 4. No tide gate, opening at 104'
- 5. No tide gate, opening at 200'
- 6. No tide gate, opening at 200, internal dike



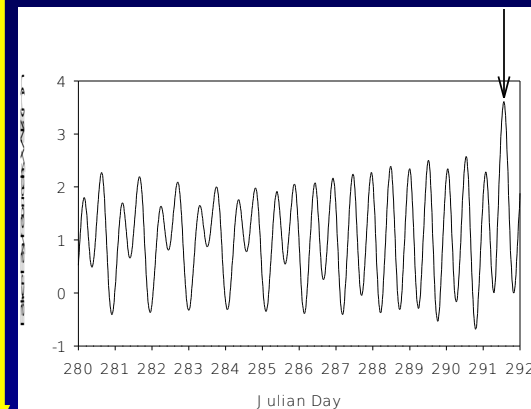
# 100-yr Surge Elevation



## Upstream Boundary Condition



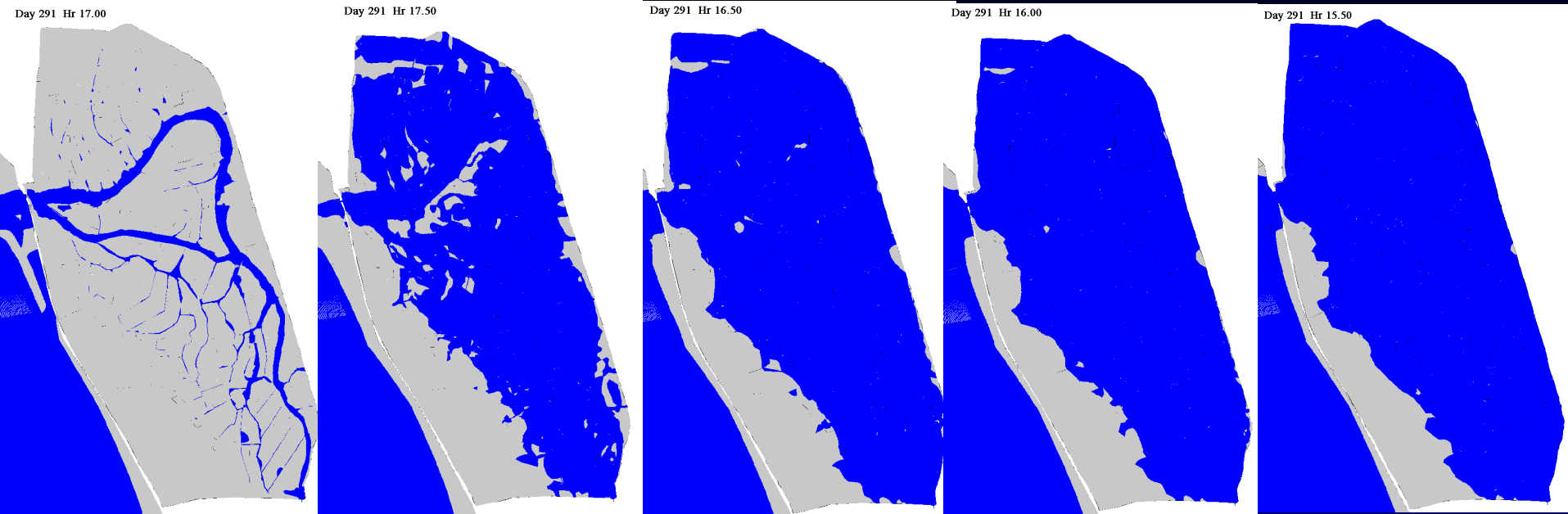
## Downstream Boundary



**Project Datum**



# Hydrodynamic Model Results Storm Surge Water Surface

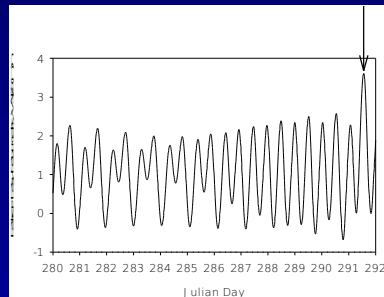


28' Opening

50' Opening

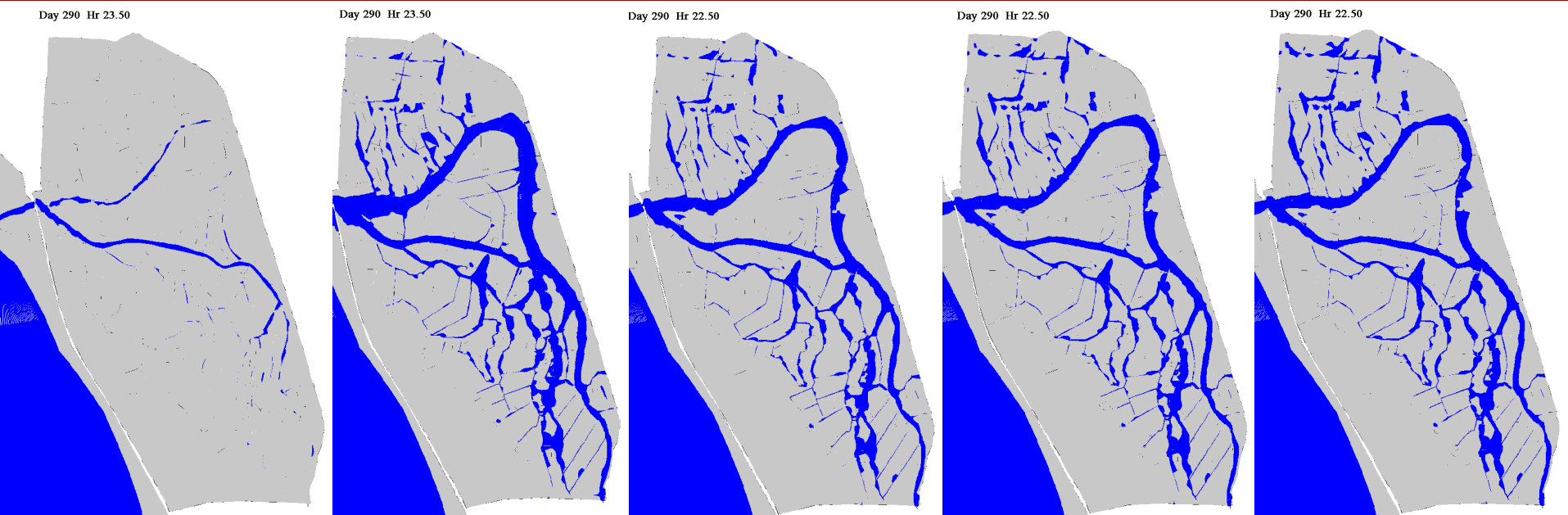
100' Opening

200' Opening





# Hydrodynamic Model Results Low Tide Water Surface

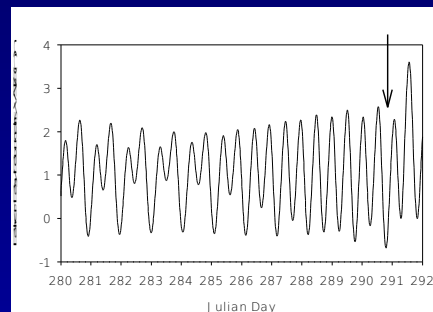


28' Opening

50' Opening

100' Opening

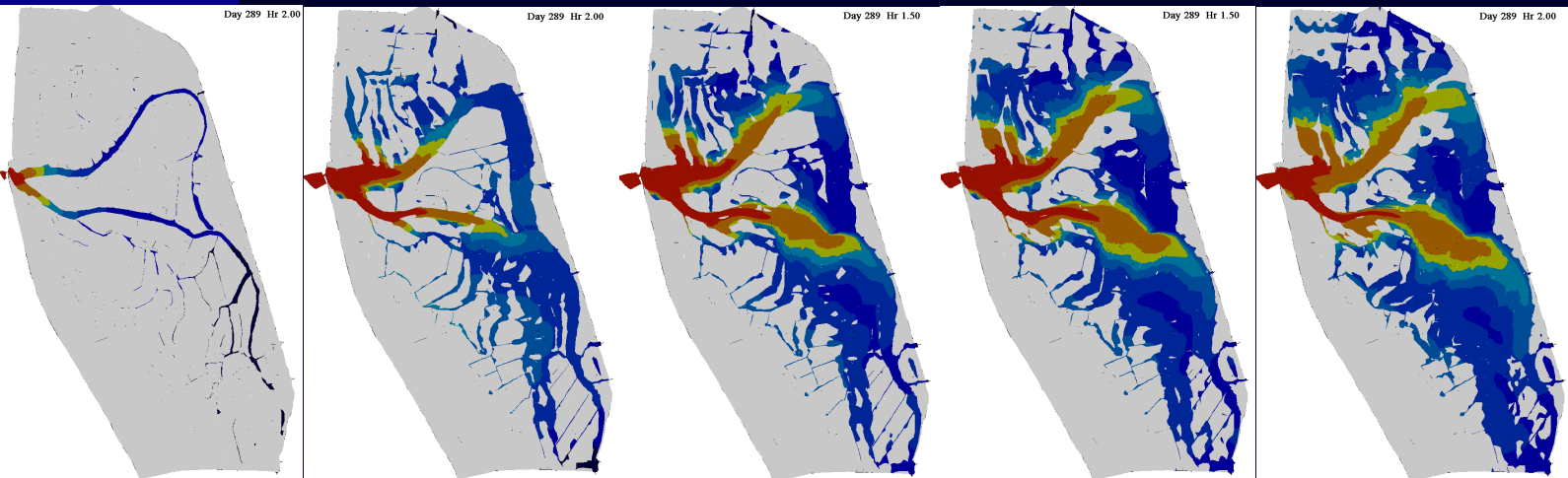
200' Opening





# Salinity Results

## Maximum Salinity at Boundary

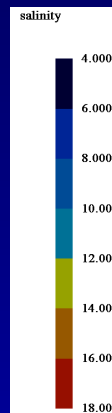
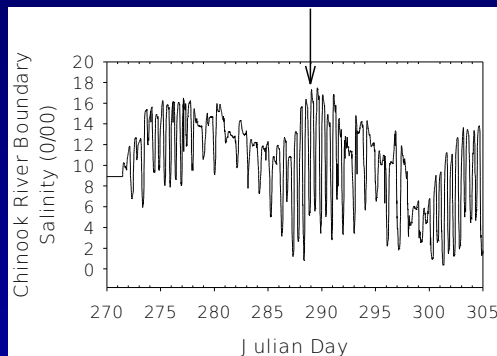


28'  
Opening

50'  
Opening

100'  
Opening

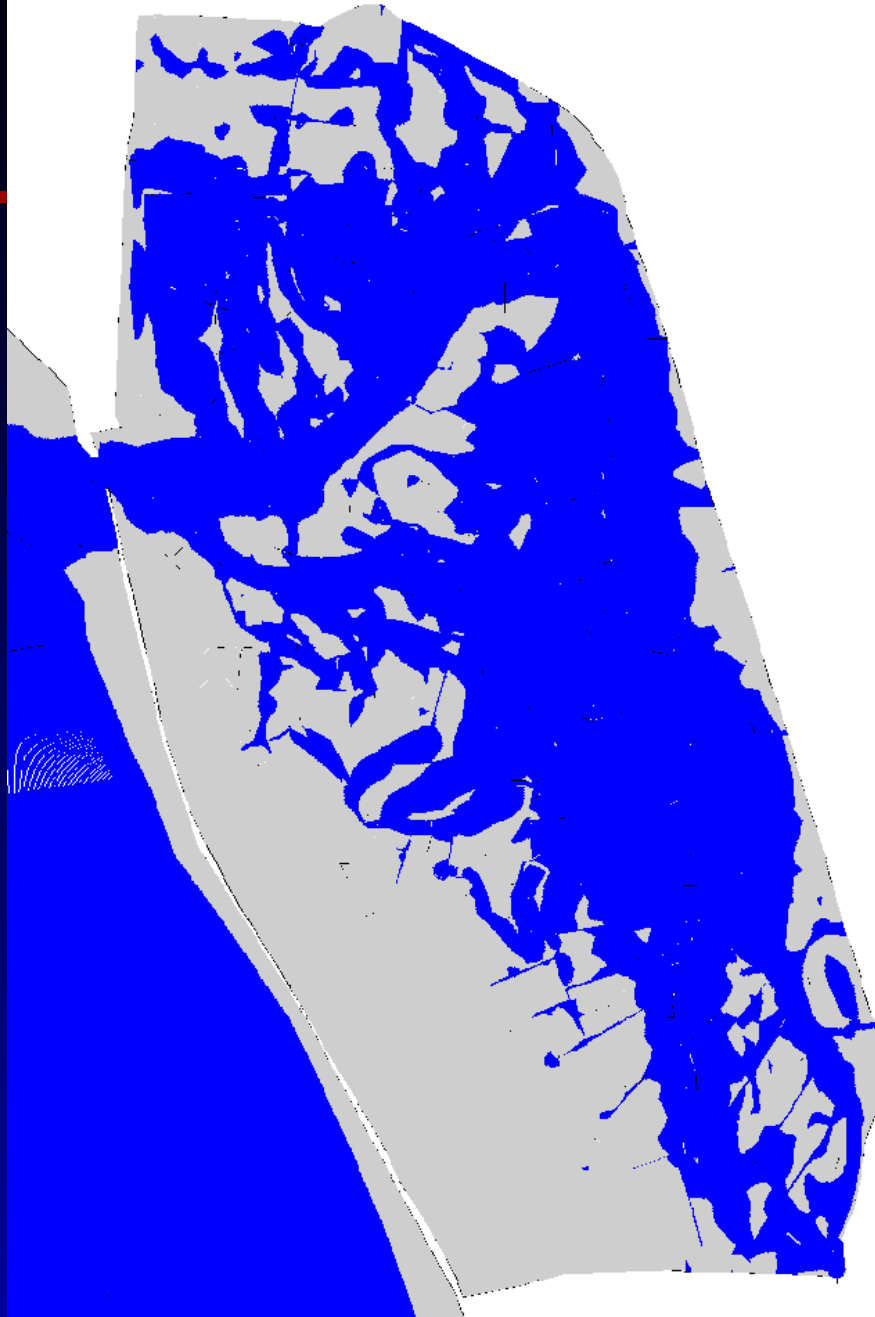
200'  
Opening



Day 289 Hr 1.50

# Hydrodynamic Model Results

Alternative 5 (200 ft width) Water Surface Animation

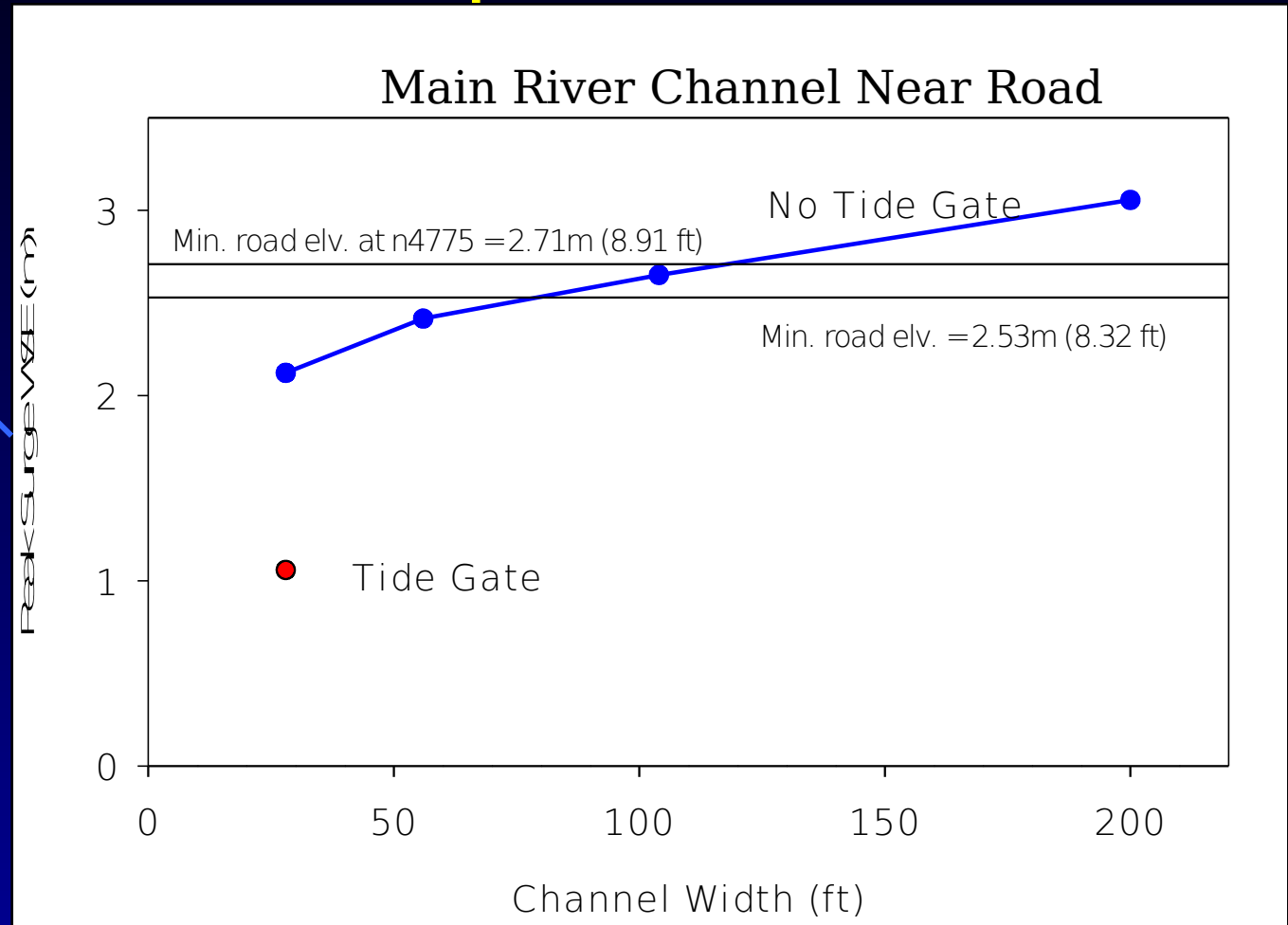
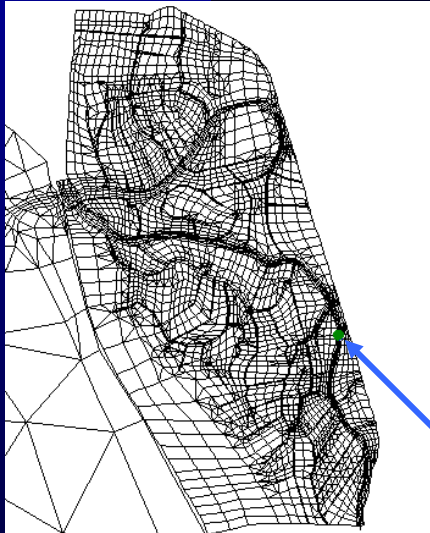




# Results

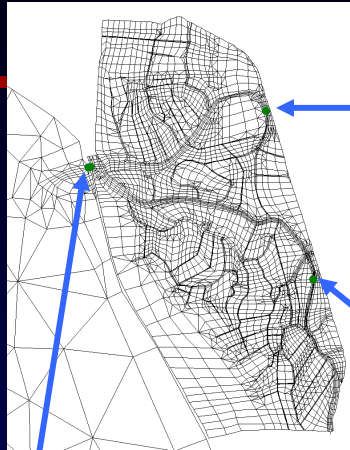
## Storm Surge WSE

### Comparison

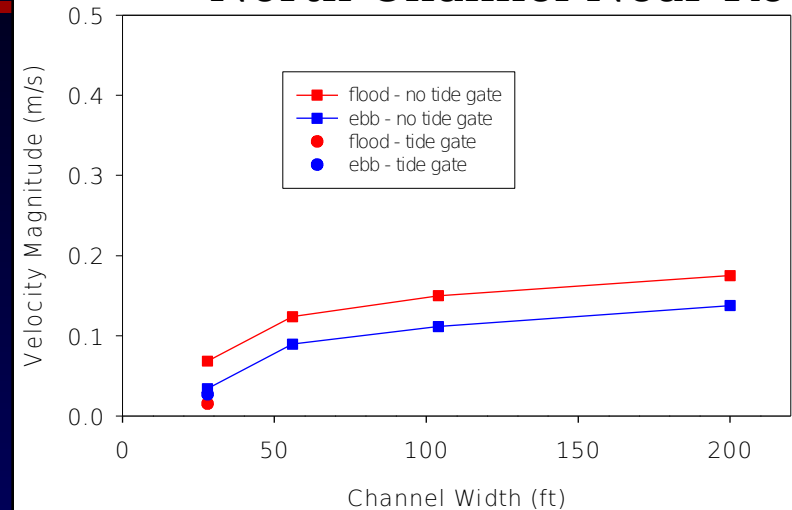


# Hydrodynamic Model Results

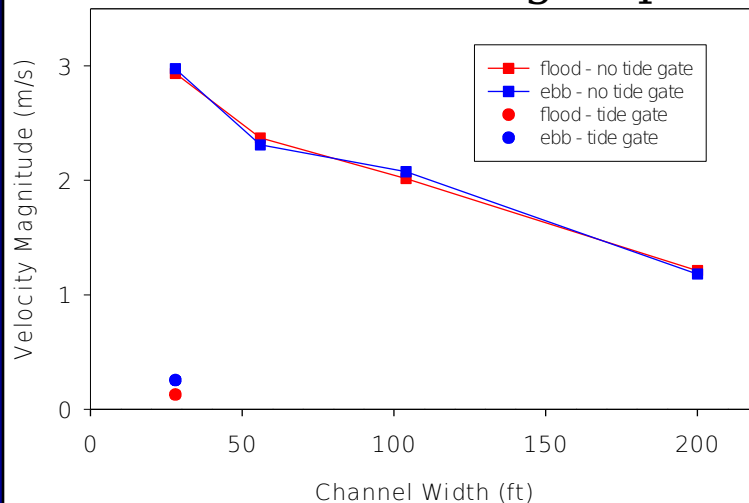
## Peak Velocities



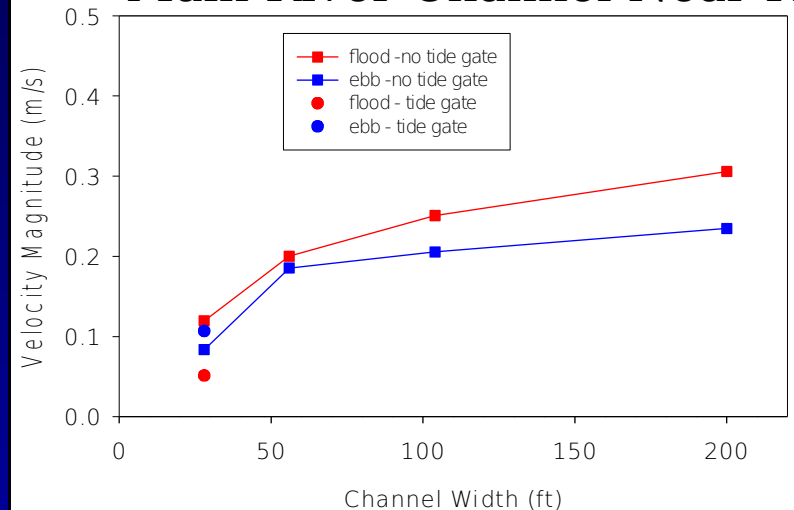
### North Channel Near Road



### Tide Gate/Bridge Opening



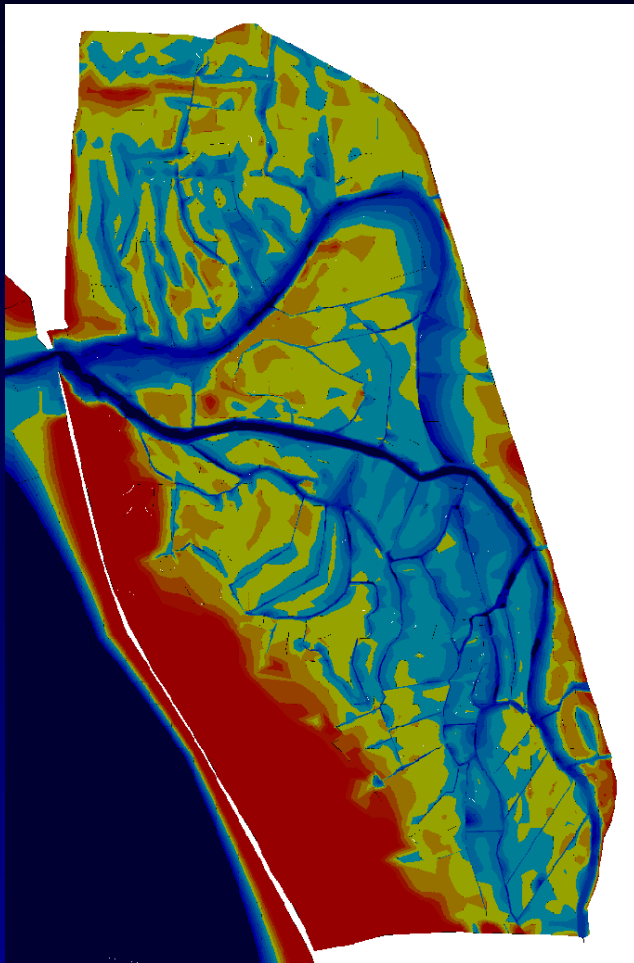
### Main River Channel Near Road



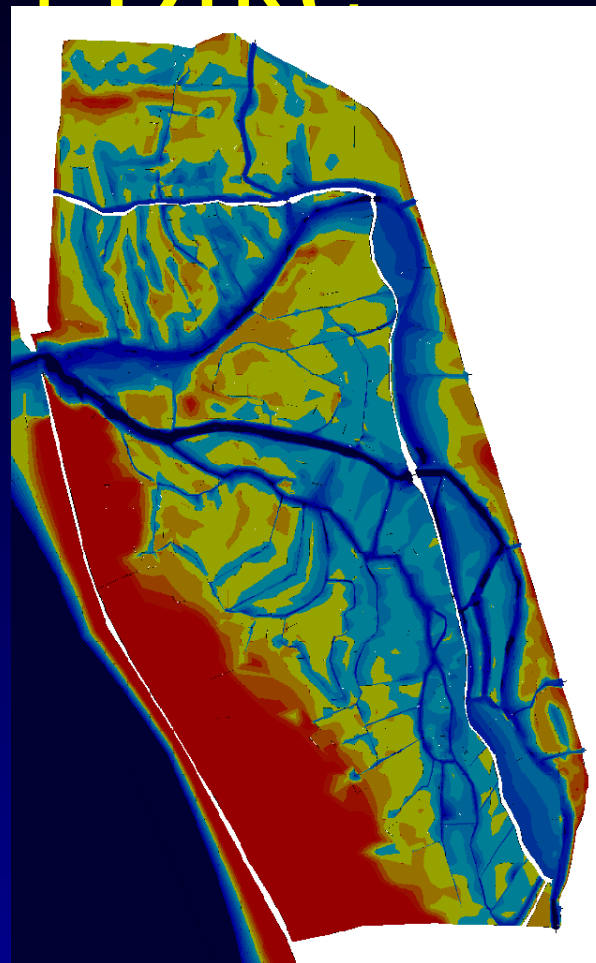


# Alternative 6

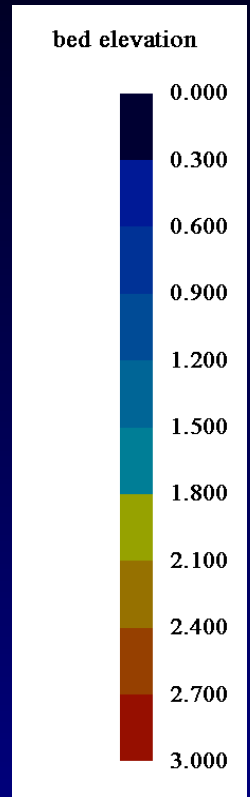
## 200' opening, no tide gate, + Dike



Alternative 5



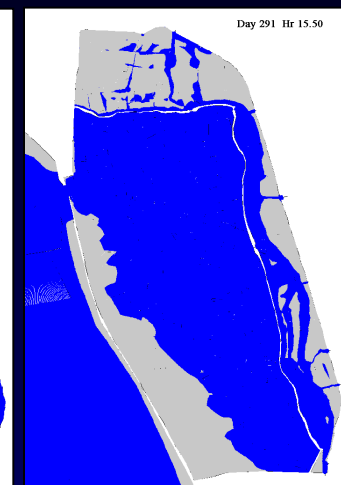
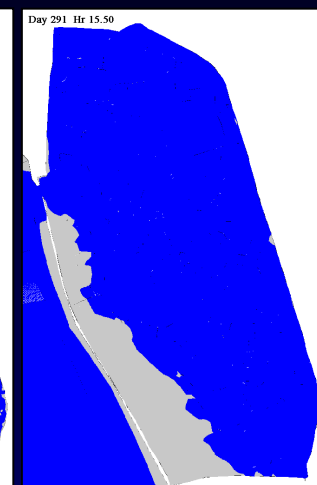
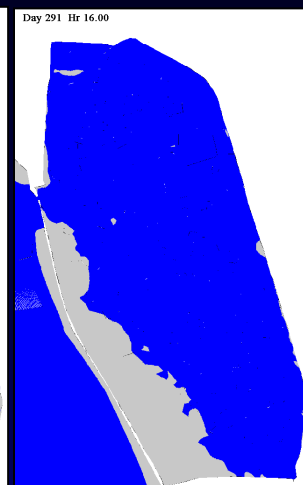
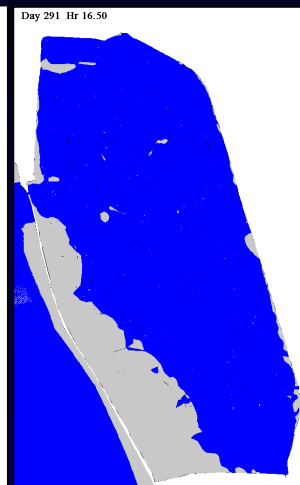
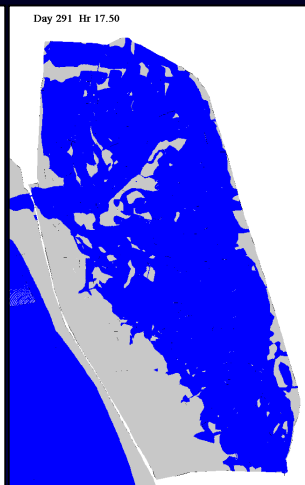
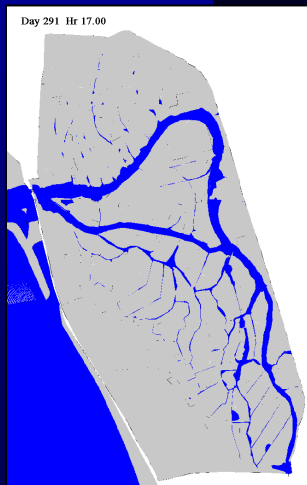
Revised Alternative 6





# Results

## Storm Surge Water Surface Elevation



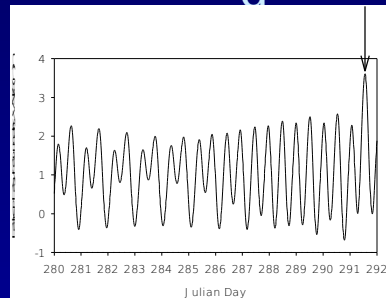
28'  
Opening

50'  
Openin  
g

100'  
Openin  
g

200'  
Openin  
g

200'  
Opening  
+  
internal  
levee

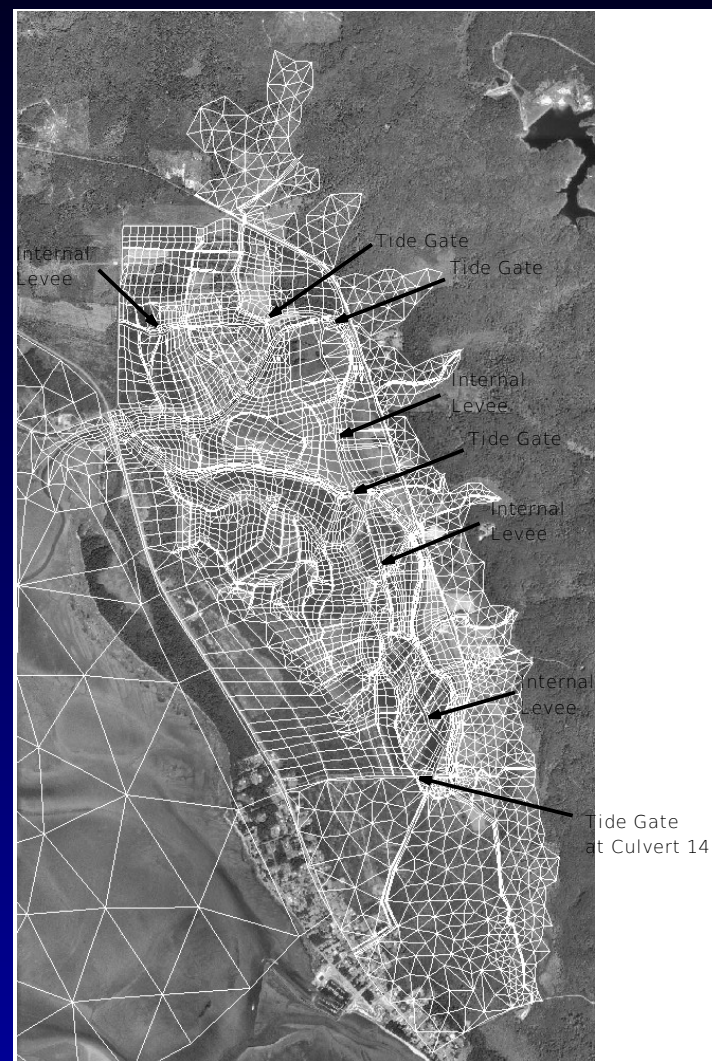
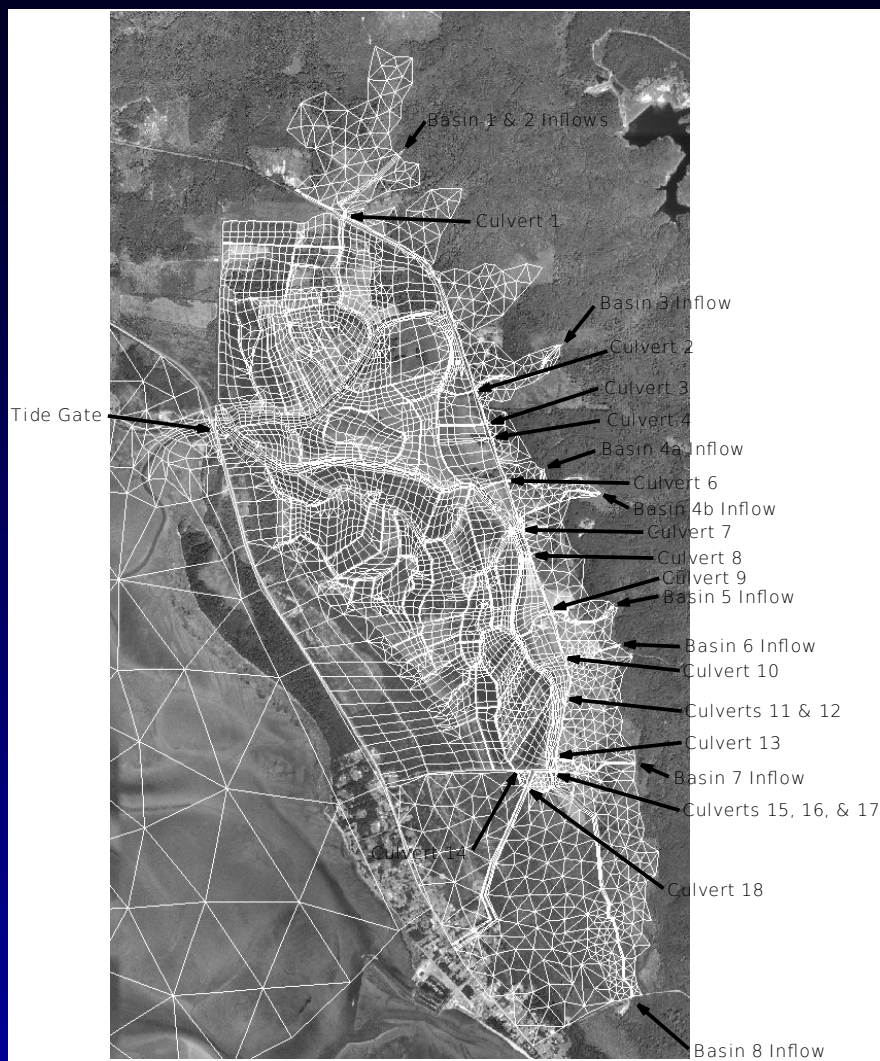




# Extended Model Grid

## Existing Condition

## Internal Levee

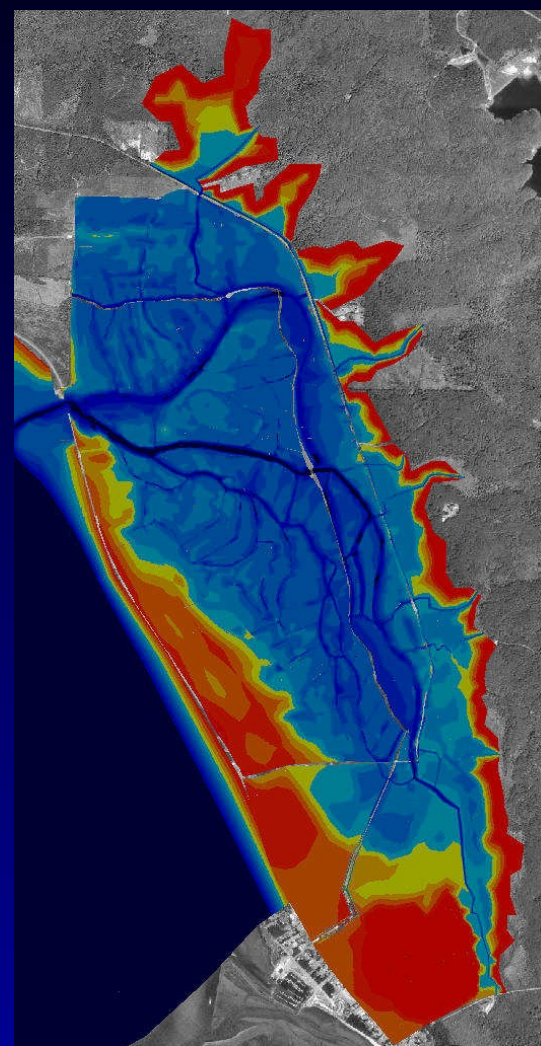
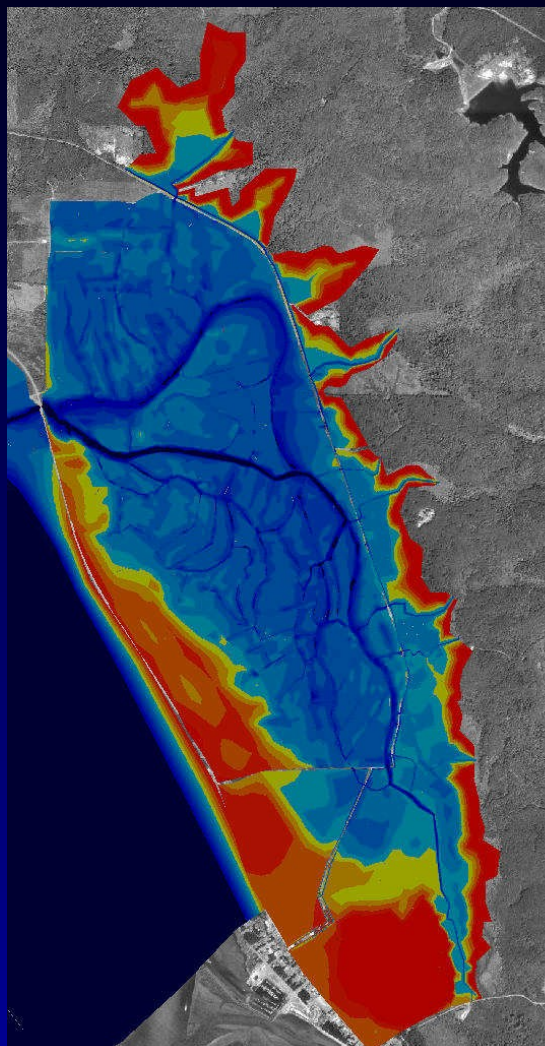
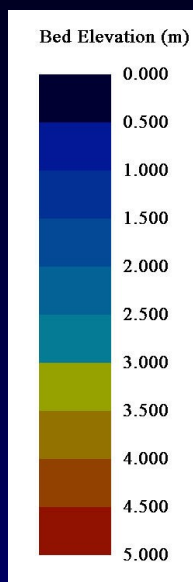




# Extended Model

## Bathymetry

Existing Condition      Internal Levee





# Results

Existing Condition - Animation  
Storm Surge and 100-year Flows





# Results

## Internal Levee - Animation Storm Surge and 100-year Flows





# Conclusions

- Restoration through tide gate removal is feasible
  - Full tidal penetration achieved with natural variation in water surface and velocities
- Narrow opening at the river mouth is not feasible due to potential scour
- Wide opening ( $>200'$ ) minimizes scour
  - Requires internal dike for storm surge protection
- Internal dike design to account for
  - Sufficient storage of upstream runoff flows
  - Tide gates to allow discharge of stored volumes